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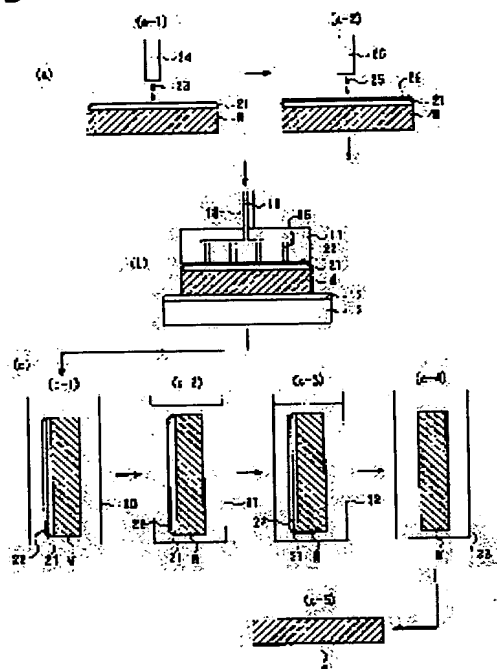
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(54) WAFER POLISHING METHOD AND WAFER WASHING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a wafer polishing method which prevents contamination caused by polishing agent and reduces nanotopography, and a wafer washing method which removes a protection film from a polished wafer readily.

SOLUTION: In a method for polishing a wafer by holding one surface of a wafer by evacuation to a holding table while adding polishing agent with the other surface of a wafer held to a polishing cloth, the other surface of a wafer is polished with a wafer. A protection film of a plurality of layer is formed in one surface and held by a holding table. A first protection film which absorbs irregularities of one surface of a wafer is formed in a side in contact with a wafer in a protection film of a plurality of layers, and a second protection film with etching resistance to polishing agent is formed in a side held by a holding table. A wafer polished by the wafer polishing method is immersed in alkaline solution, isopropyl alcohol and alkaline solution in this order and a protection film of a plurality of layers formed in a wafer is removed.



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CLAIMS

[Claim(s)]

[Claim 1] In the polish approach ground holding one field of a wafer by vacuum adsorption to the maintenance board, pressing the field of another side of this wafer to abrasive cloth, and adding an abrasive material The wafer with which the protective coat of two or more layers was formed in one field of this wafer is held by the maintenance board. It has the polish process which grinds the field of another side of this wafer. The inside of said protective coat of two or more layers, The polish approach of the wafer characterized by forming in the side in contact with a wafer the 1st protective coat which absorbs the irregularity of one field of a wafer, and forming the 2nd protective coat which has the etching-proof nature to said abrasive material in the side held at the maintenance board.

[Claim 2] It is the polish approach of a wafer according to claim 1 that said 1st protective coat is elasticity and said 2nd protective coat is characterized by being hard from the 1st protective coat.

[Claim 3] It is the polish approach of the wafer according to claim 1 or 2 characterized by said 1st protective coat having a good adhesive property with a wafer, the exfoliation after polish being easy, and said 2nd protective coat having a good adhesive property with the 1st protective coat.

[Claim 4] Said 1st protective coat is the polish approach of a wafer given in either of claims 1-3 to which thickness is characterized by 0.1-micrometer or more being 10 micrometers or less.

[Claim 5] Said 2nd protective coat is the polish approach of a wafer given in either of claims 1-4 to which it is formed with polyvinyl butyral resin, and thickness is characterized by 0.01-micrometer or more being 1 micrometer or less.

[Claim 6] The washing approach of the wafer characterized by removing the protective coat of two or more layers which is the washing approach of the wafer ground by the polish approach of a wafer according to claim 5, has the 1st process immersed in an alkaline solution in a wafer, the 2nd process immersed in isopropyl alcohol in a wafer, and the 3rd process immersed in an alkaline solution in a wafer, and was formed in said wafer.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the polish (only henceforth wafer) approaches, such as a semiconductor wafer, and a quartz, a wafer of a ceramic ingredient, and the washing approach of a wafer.

[0002]

[Description of the Prior Art] In polish processing of the wafer as a work piece which is a ground object, plates, such as glass which is a rigid ingredient, a metal, and ceramics, are made into the maintenance board, a wafer is stuck with adhesives, such as a wax, on the front face, or the approach of holding and grinding a wafer by vacuum adsorption etc. on the front face of the maintenance board which prepared many through tubes in the porous material with permeability or the front face is performed. The wafer maintenance side of this maintenance board is ground, and the front face is made flat.

[0003] When holding a wafer to such the maintenance board, while the field (rear face) of the wafer held at the maintenance board ground these people, they did not become dirty, or since it is not etched, they have proposed forming a protective coat and grinding in the precedence patent application by these people to the wafer side (Japanese Patent Application No. No. 123653 [11 to]). As this protective coat, there is etching-proof nature to an abrasive material, and polyvinyl-butyral (PVB) resin is used with the sufficient adhesive property with a wafer as a protective coat with the easy exfoliation after polish. When PVB resin is used, a wafer becomes dirty or it is lost that superfluous etching is carried out.

[0004]

[Problem(s) to be Solved by the Invention] By the way, the wave of about 0.1 micrometers exists in a wafer side. Moreover, although the wafer maintenance side of the maintenance board is made flat by polish, the wave of about 0.2 micrometers exists. If a wafer is held and ground to this maintenance board, the wave of the wafer maintenance side of the maintenance board and a wafer side will be imprinted by the polished surface of a wafer.

[0005] When forming metal wiring on a wafer, forming an insulator layer on it, carrying out flattening of this insulator layer by chemical mechanical polish (Chemical Mechanical Polishing: CMP) and forming a metal oxide film and the 2nd metal wiring on it further by the semiconductor device production process in recent years, the wave (irregularity) in the very small area called nano topography which exists in the polished surface of an above-mentioned wafer has posed a problem. Nano topography (called nano topology) is irregularity whose amplitude is several nm - about 100nm on the wavelength of 0.1mm - about 20mm. The appraisal method is the field of the circular block range (referred to as Window Size etc.) the square whose one side is 0.1mm - about 10mm, or whose diameter is 0.1mm - about 10mm, and evaluates the difference of elevation (P-V value-eak to Valley) of the irregularity on the front face of a wafer. A P-V value is Nanotopography. It is referred to as Height etc. It is desired for the maximum of the irregularity which exists in the wafer side evaluated especially to be small.

[0006] When protecting a wafer with PVB resin and grinding a wafer, since the thickness of a PVB protective coat is more thinly [than the wave of the rear face of a wafer, and the wave of the front face of the maintenance board] hard, it cannot usually perform absorption of these waves. On the other hand, when sticking a wafer on the maintenance board and grinding it through a wax, the thickness of the wax applied is usually about 1 micrometer, and since it is softer than PVB resin, it can absorb the wave of a wafer side, and the wave of a maintenance board front face. However, when holding a wafer by vacuum adsorption, since the

etching-proof nature of a wax to an abrasive material is weak, a wax melts during polish, an abrasive material is absorbed between a wafer and the maintenance board, and it is [a wax] easy, and it has the problem of being easy to be destroyed.

[0007] This invention is offering the polish approach of a wafer of reducing nano topography while it was made in view of the above-mentioned trouble and the technical problem of this invention prevents the dirt by the abrasive material. Other technical problems of this invention are offering the washing approach of a wafer of removing a protective coat from the wafer after polish easily.

[0008]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the polish approach of this invention In the polish approach ground holding one field of a wafer by vacuum adsorption to the maintenance board, pressing the field of another side of this wafer to abrasive cloth, and adding an abrasive material The wafer with which the protective coat of two or more layers was formed in one field of this wafer is held by the maintenance board. It has the polish process which grinds the field of another side of this wafer. The inside of said protective coat of two or more layers, It is characterized by forming in the side in contact with a wafer the 1st protective coat which absorbs the irregularity of one field of a wafer, and forming the 2nd protective coat which has the etching-proof nature to said abrasive material in the side held at the maintenance board.

[0009] Since the 1st protective coat which absorbs the irregularity of one field (rear face) of a wafer is formed according to this polish approach, the imprint of the irregularity of a wafer side can be prevented and the nano topography of a wafer polished surface decreases. Moreover, since the 2nd protective coat which has the etching-proof nature to said abrasive material is formed in the side held at the maintenance board, the 1st protective coat is protected from an abrasive material, exfoliation of the 1st protective coat under polish can be controlled, and a wafer side is protected. Moreover, since the 2nd protective coat is not eaten away by the abrasive material, a wafer can be ground, without a wafer side's becoming dirty or being etched.

[0010] Others are sufficient, as long as it is not limited to this but can absorb the magnitude of the irregularity of a wafer side or a maintenance board front face, although the liquid glue of the wax used for attachment of a wafer, for example, a rosin system, is typical as the 1st protective coat here. Furthermore, if the magnitude of the foreign matter mixed between the maintenance board and a wafer etc. at a polish process is absorbable, the crater of a polished surface and distortion can be reduced. Moreover, as the 2nd protective coat, although the PVB resin of polyvinyl-acetal system resin is mentioned, it is not limited to this. For example, the acrylic resin which there is etching-proof nature to an abrasive material, and can protect the 1st protective coat from an abrasive material is sufficient.

[0011] Said 1st protective coat is elasticity and, as for said 2nd protective coat, it is more desirable than the 1st protective coat that it is hard. As for especially the 1st protective coat, it is desirable that it is soft to extent which can absorb the magnitude of the irregularity of the front face of the maintenance board, a through tube, a wafer side, etc., a foreign matter, etc.

[0012] Moreover, the 1st protective coat has a good adhesive property with a wafer, and, as for the 2nd protective coat, it is desirable that an adhesive property with the 1st protective coat is good. In this case, it can control that an abrasive material enters between protective coats and between a protective coat and a wafer, and a protective coat is destroyed, the dirt of the rear face of a wafer can be prevented, and a wafer can be ground. Therefore, the poor dirt of a wafer can be reduced. Furthermore, as for the 1st protective coat, it is desirable for the exfoliation after polish to be easy.

[0013] As for the 1st protective coat, it is desirable that thickness is 0.1 micrometers or more 10 micrometers or less. If thicker [if thinner than 0.1 micrometers, irregularity of a wafer side cannot be absorbed, but] than 10 micrometers, the display flatness of the wafer after polish will get worse, and also this is for washing to take time amount.

[0014] On the other hand, when formed with polyvinyl butyral resin, as for the 2nd protective coat, it is desirable that thickness is 0.01 micrometers or more 1 micrometer or less. This is because there is a possibility of separating during polish when thinner than 0.01 micrometers, and when it is thicker than 1 micrometer, it is because long time amount is needed for washing after polish.

[0015] The washing approach of the wafer of this invention is the washing approach of the wafer ground by the polish approach of an above-mentioned wafer, has the 1st process immersed in an alkaline solution in a wafer, the 2nd process immersed in isopropyl alcohol in a wafer, and the 3rd process immersed in an alkaline

solution in a wafer, and is characterized by removing the protective coat of two or more layers formed in said wafer. According to this washing approach, the protective coat of two or more layers is easily removable from a wafer only by a wafer being immersed in a penetrant remover. As an alkaline solution, the mixed liquor of aqueous ammonia and hydrogen peroxide solution is typical.

[0016]

[Embodiment of the Invention] Although the polish approach of the wafer concerning this invention and the washing approach of a wafer are hereafter explained with reference to drawing, unless it deviates from the technical thought of this invention, it cannot be overemphasized that various deformation is possible. The outline block diagram, drawing 2, and drawing 3 of polish equipment of the wafer which enforces the polish approach which drawing 1 requires for this invention show the process of the art of the wafer concerning this invention, drawing 2 is a process approximate account Fig., and drawing 3 is a process block diagram. Polish equipment 10 holds one field (rear face) of Wafer W by vacuum adsorption to the maintenance board 11, presses it to the abrasive cloth 13 on which the field of another side of Wafer W was stuck on the rotation surface plate 12, and it is ground, adding an abrasive material 15 from the abrasive material feeder 14. Many through tubes 16 (drawing 2) for carrying out vacuum adsorption of the wafer W are formed in the maintenance board 11, and the wafer maintenance side is ground beforehand.

[0017] As shown in drawing 2, the 1st protective coat 21 is formed in the rear face of Wafer W, and the 2nd protective coat 22 is formed in it so that this 1st protective coat 21 may be covered. As the 1st protective coat 21, alkali resistance may be weak and the wax for wafer adhesion is used. Thickness of the 1st protective coat 21 is set to 0.1 micrometers or more 10 micrometers or less. It was referred to as 0.1 micrometers or more for absorbing the irregularity of about 0.1 micrometers of the rear face of Wafer W, and having been referred to as 10 micrometers or less prevents aggravation of the display flatness of the polished surface of Wafer W, and it is for compaction of washing time amount. Moreover, in order to also absorb the irregularity of about 0.2 micrometers of the front face of the maintenance board 11, thickness of the 1st protective coat 21 is preferably set to 0.3 micrometers or more 2 micrometers or less for display flatness aggravation prevention of the polished surface of Wafer W, and washing time amount compaction.

[0018] As the 2nd protective coat 22, it is the thing of the quality of the material harder than the 1st protective coat 21, and a strong alkali-proof thing is used. An abrasive material 15 is usually for pH=10-11. PVB resin is used as this 2nd protective coat 22. As for the polymerization degree of PVB resin, 300 to about 1000 are desirable. Moreover, the 2nd protective coat 22 sets thickness to 0.01 micrometers or more 1 micrometer or less, and sets it to 0.1 micrometers or more 0.3 micrometers or less preferably. When too thick [if too thin, exfoliation of the 2nd protective coat 22 under polish cannot be prevented, but], it is because the washing time amount after polish becomes long. In order to prevent destroying the 1st protective coat 21 during polish, it is desirable to cover the 1st protective coat 21 completely by the 2nd protective coat 22.

[0019] Where it made the maintenance board 11 carry out vacuum adsorption of this 2nd protective coat 22 side and Wafer W is held to the maintenance board 11, one side polish of the field of another side of Wafer W is carried out using the polish equipment 10 shown in drawing 1.

[0020] By minding between the wafer maintenance side of the maintenance board 11, and Wafer W, the imprint of the irregularity of the rear face of the front face of the maintenance board 11, a through tube 16, and Wafer W, a foreign matter, etc. is lost, and the nano topography and the crater of a polished surface of Wafer W reduce the 1st soft protective coat 21. Moreover, although it is easy to separate by the abrasive material 15 only in the 1st soft protective coat 21, such as a wax, it can grind, without the rear face of Wafer W becoming dirty, or being etched, without the 1st protective coat 21 and the 2nd protective coat 22 separating by protecting Wafer W so that there may be alkali resistance and the 1st protective coat 21 may be covered by hard PVB resin.

[0021] Next, the art of Wafer W is explained. First, the 1st soft protective coat 21 is formed in the rear face of Wafer W in a protective coat formation process (a) (a-1). This 1st protective coat 21 trickles the liquid-like wax 23 with the spin coat means 24, rotates Wafer W, is applied to the whole wafer side, and is formed by performing heat treatment for 30 seconds - 720 seconds at the temperature of 50 degrees C - 200 degrees C. And the 2nd protective coat 22 of the PVB resin which is hard synthetic resin as the 1st protective coat 21 is covered is formed on the 1st protective coat 21 (a-2). This 2nd protective coat 22 trickles the solution 25 which melted PVB resin to IPA (PVB resin concentration 0.2 mass % - 5.0 mass %) on the 1st protective coat 21 with the spin coat means 26, rotates Wafer W, is applied, and is formed by performing heat treatment for

30 seconds - 720 seconds at the temperature of 50 degrees C - 200 degrees C.

[0022] The wafer W with which the two-layer protective coats 21 and 22 were formed in the rear face is ground by polish equipment 10 in a wafer polish process (b). Under the present circumstances, a vacuum is generated with the non-illustrated vacuum devices connected through the vacuum way 19 from a through tube 16, the rear face of Wafer W is held by vacuum adsorption to the wafer maintenance side of the maintenance board 11, and Wafer W is pushed against abrasive cloth 13 by the predetermined load. The rotation surface plate 12 is rotated centering on a revolving shaft 17, and the maintenance board 11 rotates centering on a revolving shaft 18. And Wafer W is ground by rotating Wafer W, supplying an abrasive material 15 between Wafer W and abrasive cloth 13 from the abrasive material feeder 14.

[0023] Then, in a wafer washing process (c), the 1st protective coat 21 and the 2nd protective coat 22 are removed from Wafer W. First, Wafer W is immersed in the washing tub 30 of aqueous ammonia + hydrogen peroxide solution for [30 seconds -] 600 seconds at the temperature of 50 degrees C - 90 degrees C (c-1). Next, Wafer W is immersed in the washing tub 31 of isopropyl alcohol (IPA) for [30 seconds -] 600 seconds at the temperature of 20 degrees C - 50 degrees C (c-2). And it is immersed in the washing tub 32 of aqueous ammonia + hydrogen peroxide solution for [30 seconds -] 600 seconds at the temperature of 50 degrees C - 90 degrees C (c-3). At this time, the 1st protective coat 21 and the 2nd protective coat 22 are removed from Wafer W. Then, Wafer W is immersed in the pure-water rinse tub 34 (c-4). Finally, Wafer W is dried (c-5).

[0024]

[Example] PVB resin (degree of polymerization: whenever [1000 and butyral-ized] :71-mol%) was used for the 2nd protective coat 22 of a wax (liquid glue of a rosin system), and the hard quality of the material at the 1st protective coat 21 of the soft quality of the material. In the protective coat formation process (a), after the liquefied wax 23 was dropped at the rear face of Wafer W with the spin coat means 24, the wax 23 was opened at the whole rear face of Wafer W, rotating Wafer W by 3200rpm, without rotating Wafer W in the room temperature of 24 degrees C. And after stopping rotation of Wafer W and heat-treating at 100 degrees C, it cooled at 24 degrees C and the 1st protective coat 21 with a thickness of 1 micrometer was formed.

[0025] Next, after the solution 25 which melted PVB resin to IPA (PVB resin concentration 2.5 mass %) was dropped with the spin coat means 26, rotating Wafer W by 500rpm in the room temperature of 24 degrees C, it extended, rotating Wafer W by 1800rpm so that the 1st protective coat 21 might be covered with a solution 25. And after stopping rotation of Wafer W and performing heat treatment for 60 seconds at 150 degrees C, it cooled at 24 degrees C and the 2nd protective coat 22 with a thickness of 0.2 micrometers was formed.

[0026] Thus, after protecting Wafer W, at the wafer polish process (b), Wafer W was ground for 15 minutes, supplying the colloidal silica abrasive material 15 of pH=10.5 on abrasive cloth 13 by polishing pressure force 300 g/cm² with the one side polish equipment shown in drawing 1 using Suba600 marketed from Rodel, Inc. as abrasive cloth 13.

[0027] After polish, by the wafer washing process (c), after Wafer W was first immersed in the rinse tub for 5 minutes at 24 degrees C, it was immersed in the washing tub 30 of aqueous ammonia + hydrogen peroxide solution (30 mass % hydrogen peroxide solution: 28 mass % aqueous ammonia : water =0.1: 1:10) for 5 minutes at 80 degrees C. Next, after Wafer W was immersed in the rinse tub for 5 minutes at 24 degrees C, it was immersed in the washing tub 31 of IPA (99.99 mass %) for 5 minutes at 24 degrees C. Then, after Wafer W was immersed in the rinse tub for 5 minutes at 24 degrees C, it was immersed in the washing tub 32 of aqueous ammonia + hydrogen peroxide solution (30 mass % hydrogen peroxide solution: 28 mass % aqueous ammonia : water = 1:1:10) for 5 minutes at 80 degrees C. And after being immersed in the pure-water rinse tub 33 for 5 minutes at 24 degrees C, it dried. Thus, while the nano topography measuring device (ADE company make, WIS-CR83-SQM) estimated the nano topography of the wafer ground and washed, etching and dirt by the abrasive material were evaluated.

[0028] Moreover, as an example 1 of a comparison, except having protected the wafer by the PVB resin protective coat of a monolayer with a thickness of 0.2 micrometers, it ground on the same conditions as an example, and the wafer from which the protective coat was removed was similarly estimated as the example. Furthermore, as an example 2 of a comparison, except having protected the wafer by the wax protective coat of a monolayer with a thickness of 1 micrometer, it ground on the same conditions as an example, and the wafer from which the protective coat was removed was similarly estimated as the example.

[0029] Table 1 expresses the measurement result of the nano topography of each wafer of an example, the example 1 of a comparison, and the example 2 of a comparison. Measurement of nano topography divided the

field of a wafer into the field of the square block range (Window Size) whose one side is 0.5mm, 2.0mm, and 10.0mm, and evaluated the P-V value (Nanotopography Height) in each field. And Nanotopography which exists in the evaluated wafer side The maximum of Height was calculated.

[0030]

[Table 1]

Window Size	Nanotopography Height (nm)		
	0.5mm × 0.5mm	2.0mm × 2.0mm	10.0mm × 10.0mm
実施例 (2層保護膜)	11.6	19.8	41.5
比較例 1 (PVB 保護膜)	18.9	36.0	66.7
比較例 2 (ワックス 保護膜)	18.0	35.5	65.5

[0031] From Table 1 to which Window Also in Size, it turns out that the nano topography of an example which protected by the two-layer protective coat reduced compared with the example 1 of a comparison, and the example 2 of a comparison. Although checked about etching and dirt by the abrasive material by neither the example nor the example 1 of a comparison, as for the example 2 of a comparison protected by the monolayer protective coat of only a wax, the protective coat almost melted during polish, and the percent defective of rear-face dirt was about 100%. Since the wax protective coat melted in the case of the example 2 of a comparison, the irregularity of a wafer side and the irregularity of a maintenance board front face were imprinted by the polished surface, and nano topography got worse on a par with the example 1 of a comparison protected by the PVB resin protective coat.

[0032] As mentioned above, as it is, if the optimal quality of the material and the thing of the especially optimal hardness are selected also by much more protective coat, although protection etc. is possible In order to prevent etching by an imprint and abrasive material of the configuration of the maintenance board etc. to coincidence If the protective coat more than two-layer is formed and the hardness and etching-proof nature are changed, an imprint, and dirt and etching by the abrasive material can be lost more easily and nearly completely, and it can reduce the nano topography, the poor crater, and poor dirt of a wafer.

[0033]

[Effect of the Invention] Since the 1st protective coat which absorbs the irregularity of a wafer side is formed according to the polish approach of the wafer by this invention, the imprint of the irregularity of a wafer side etc. can be prevented and the nano topography of a wafer polished surface decreases. Moreover, since the 2nd protective coat which has the etching-proof nature to said abrasive material is formed in the side held at the maintenance board, the 2nd protective coat is not eaten away by the abrasive material, but the 1st protective coat is protected from an abrasive material, exfoliation of the 1st protective coat under polish can be controlled, and a wafer side is protected. Therefore, the poor dirt of the rear face of a wafer decreases.

[0034] According to the washing approach of the wafer by this invention, the protective coat of two or more layers is easily removable from a wafer only by a wafer being immersed in a penetrant remover.

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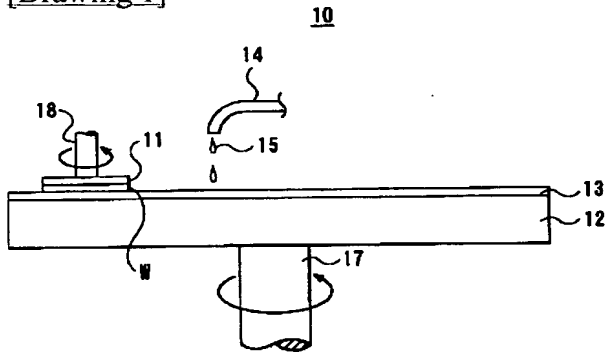
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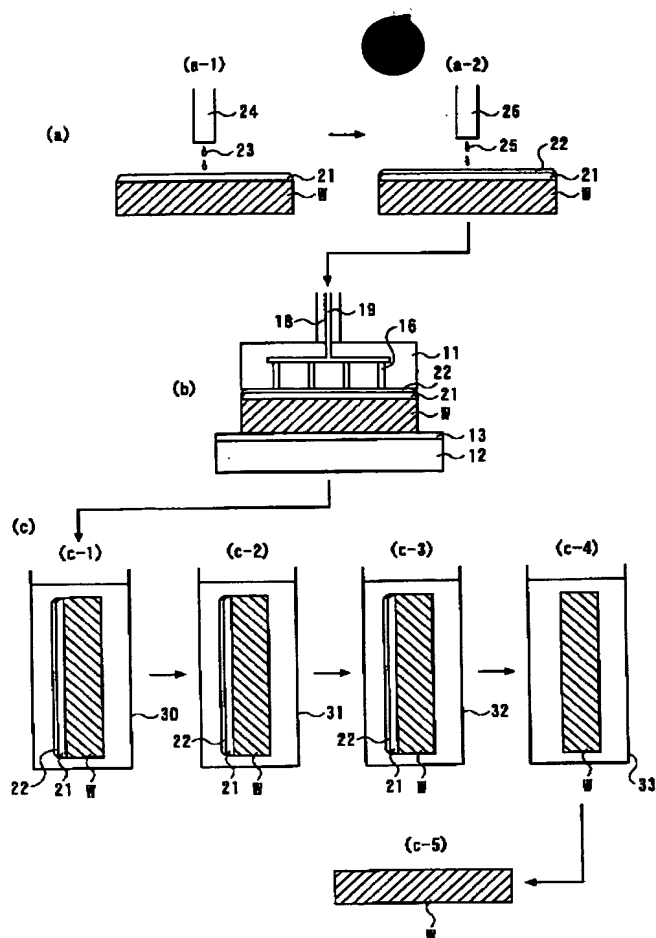
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DRAWINGS

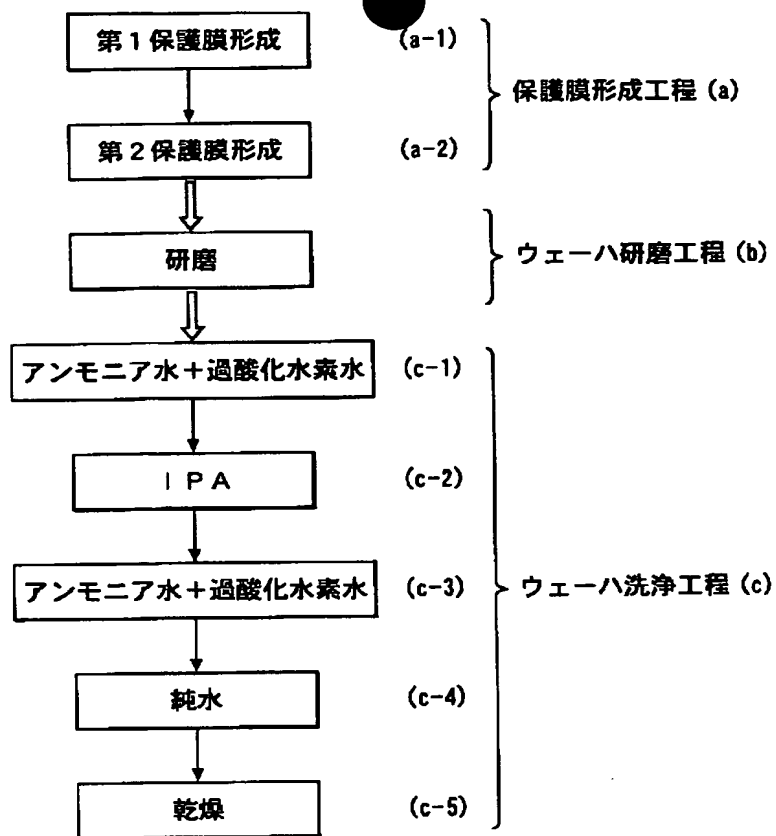
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]